Overview of Pepco's Electric System
District of Columbia

August 23, 2012

Discussion Topics

- Overview of Electric System Within the District of Columbia
- Reliability Comparison of Overhead and Underground Systems
- Reliability Enhancement Plan
- Power Restoration Process
- Regional Mutual Assistance

Distribution Operations Overview

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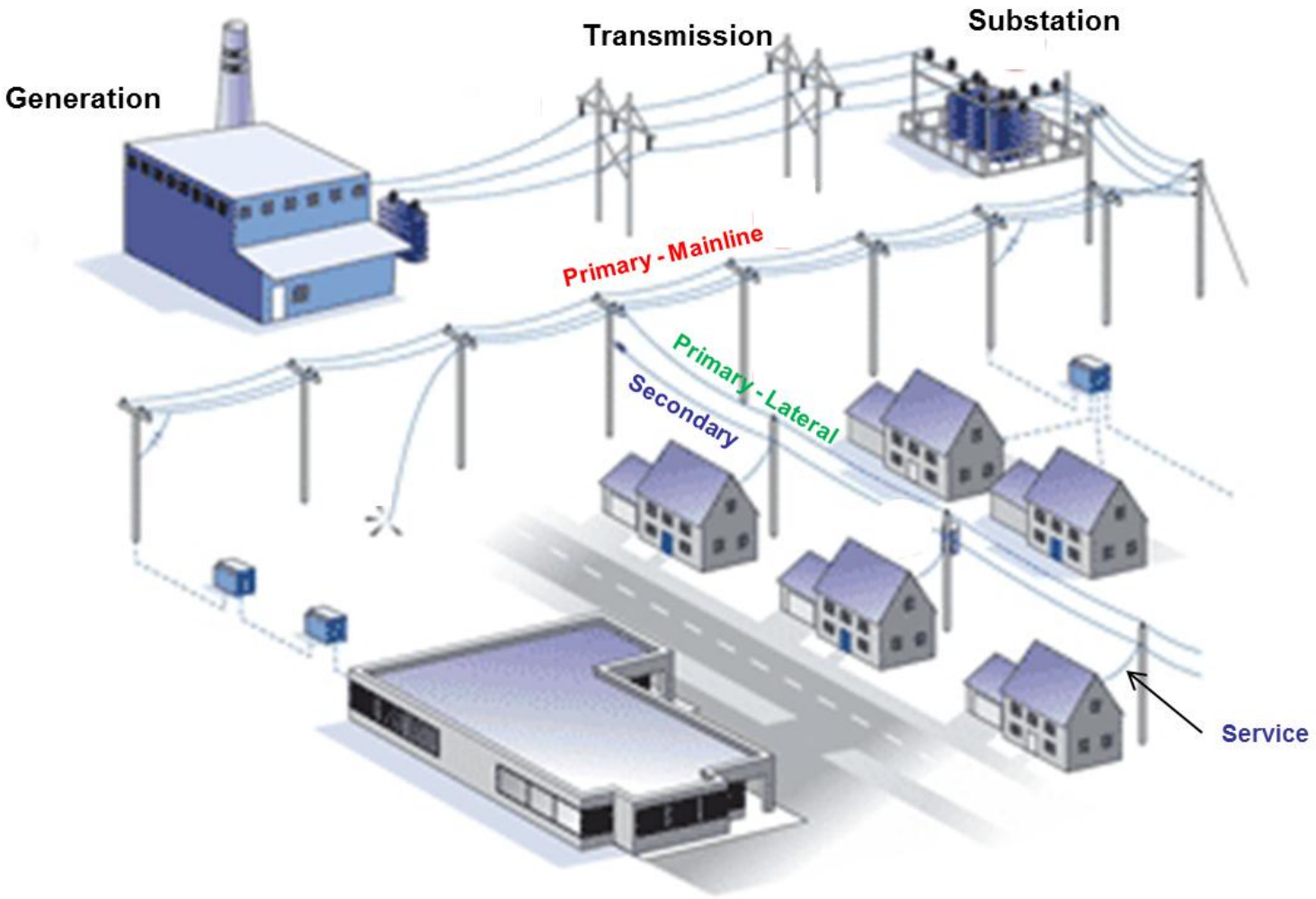
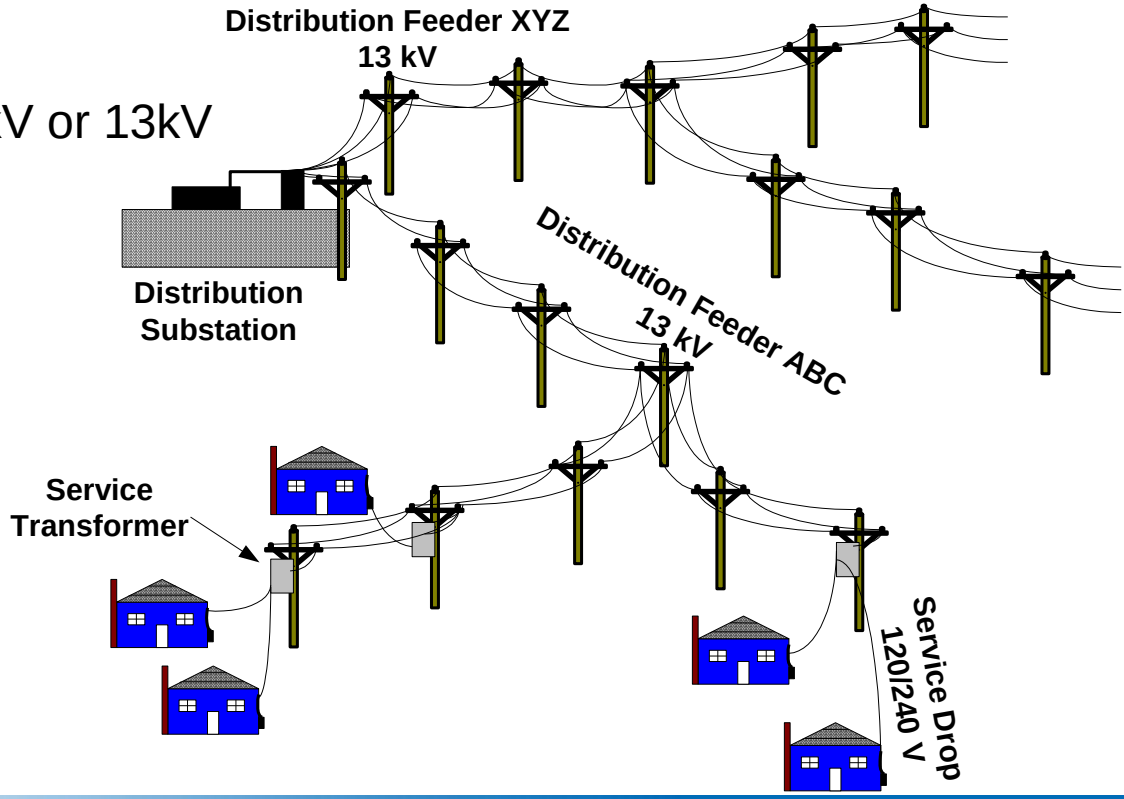


Distribution System

- Distribution is the process of delivering electric power from the transmission system to end-use customers
- Most typically accomplished via radial medium voltage feeders and low voltage service connections
- Sometimes accomplished via low voltage underground networks (e.g. downtown areas)
- Typical medium voltages – 4 kV or 13kV
- Home delivery voltages are usually 120/240 volts



Distribution Feeders

- Electrical connections from the substation to the customer, which includes wire, cable, fixtures, transformers & devices, and poles and towers for overhead construction

- Can be overhead or underground
  - Underground typically cost $2 to $5 million per mile to install
  - Overhead typically cost $100,000 to $200,000 per mile to install

- Can be connected in a radial or networked (meshed) fashion
  - Distribution is mostly radial in residential and small commercial areas
  - Densely loaded areas frequently networked
    - Central business districts
    - Downtown metropolitan areas

- Within the District of Columbia the building code outlines the portion of the city where overhead wires have never been allowed

Note: Shaw Study estimates $3M per mile.

Types of Distribution Feeder

- Poles, conduit, fixtures, wire, & cable
- Supporting structures and electric conductors

Poles, wires, fixtures

Conduit configured into a “duct bank”

Cable direct buried

District of Columbia's Electric System Overview

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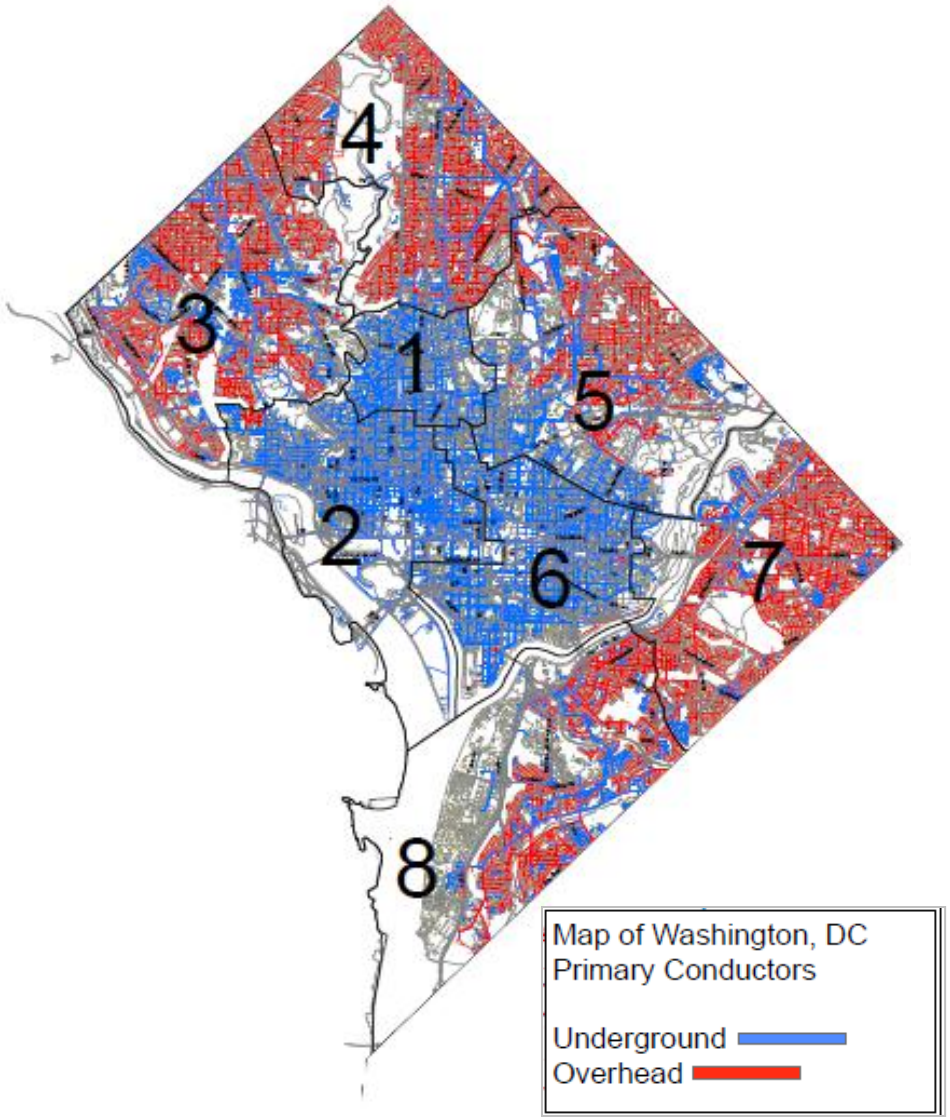
Number of Substations	UG feed	OH feed	Total
Distribution	36	15	51
Transmission	7	0	7
Total	43	15	58

Circuit Miles	UG	OH	Total
Primary (4 and 13kV class)	1,699 miles (72%)	645 miles (28%)	2,344 miles
Secondary (120/240, 120/208)	937 miles (54%)	788 miles (46%)	1,725 miles
Totals	2,636 miles (65%)	1,433 miles (35%)	4,069 miles

Customers by feeder	4kV	13kV	Total	% of Total
>=85% Overhead	27,742	28,495	56,237	22%
100% Underground	10,168	104,964	115,132	35%
Mixed	10,008	75,048	85,056	43%
Total	47,918	208,507	256,425	100%

Customers by Service	Total	% of Total
Overhead	101,737	40%
Underground	154,908	60%
Total	256,745	100%

District of Columbia's Electric System Overview



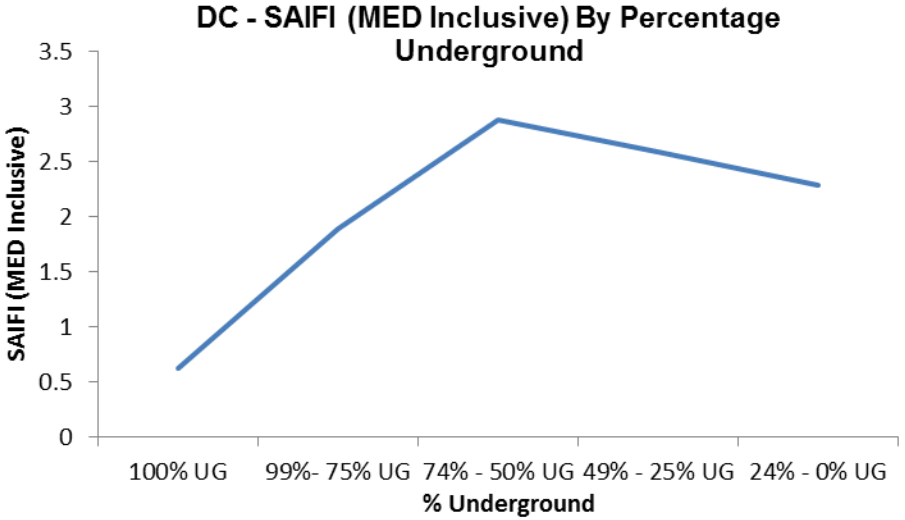
Pepco DC System

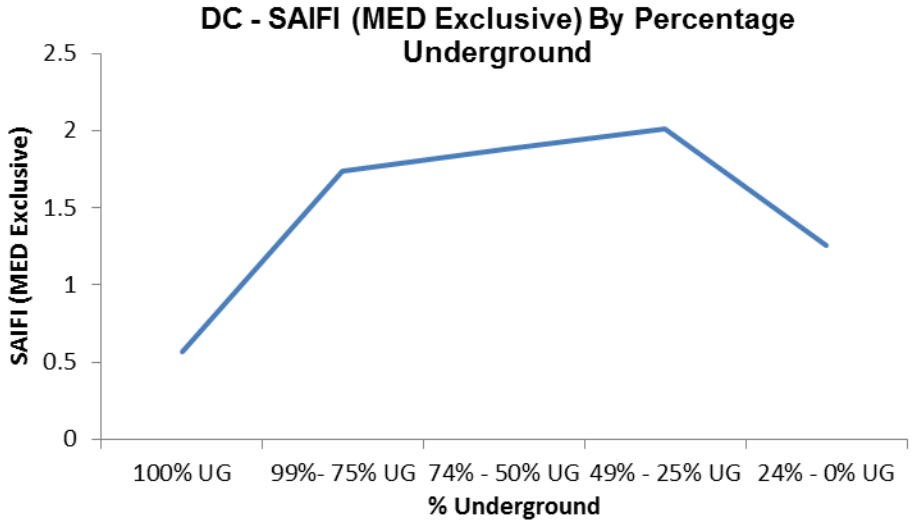
- 1,433 miles of overhead lines (35%)
- 2,636 miles of underground lines (65%)
- 60% of customers are served by underground service
- 40% of customers are served by overhead service

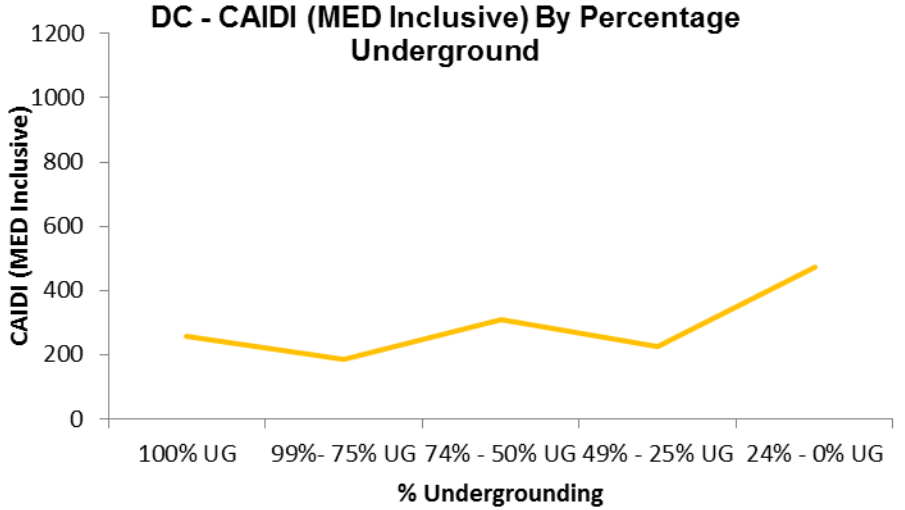
Customers by Feeder

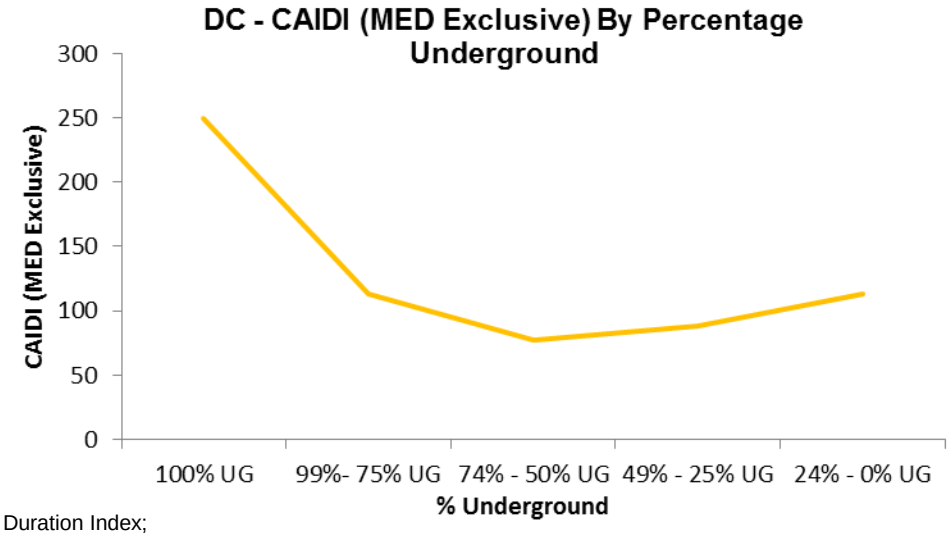
- 35% of customers are on 100% underground feeders
- 22% of customers are on feeders that are >= 85% underground
- 43% of customers are on mixed feeders

Reliability Comparison of Overhead and Underground Systems



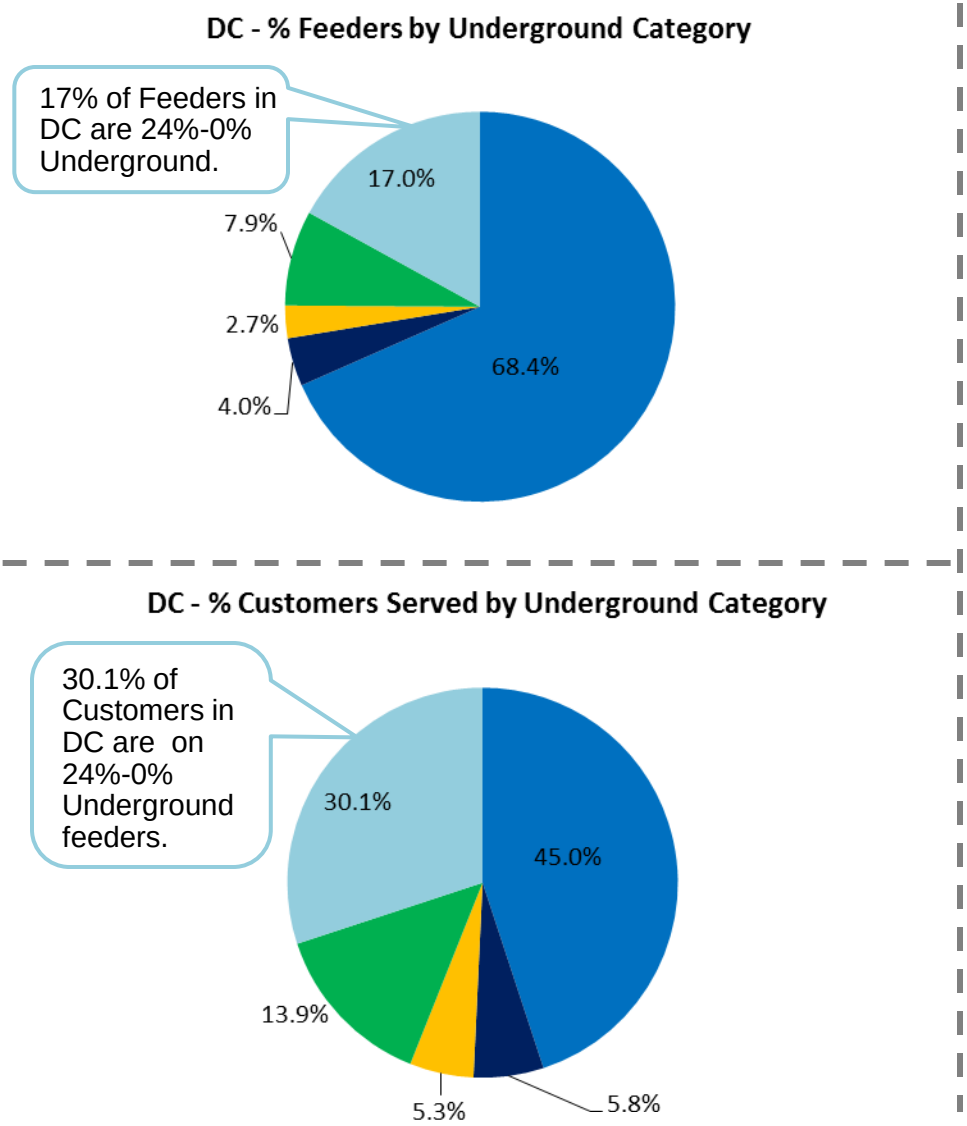






SAIFI – System Average Interruption Frequency Index; CAIDI – Customer Average Interruption Duration Index;
Major Event Days (MED) Exclusive - Excludes MEDs; Major Event Days (MED) Inclusive – Includes MEDs

Reliability Comparison



17% of feeders in DC that are more then 75% overhead construction account for 43% of the customer outages.

The Reliability Enhancement Plan (REP) Initiatives

The REP includes the following increments, it is a dynamic plan and will continue to be updated as necessary and as results demonstrate effectiveness of the mitigations executed

Program	Goal
Vegetation Management	Performing on a 2 year growth cycle (Pepco DC), removal of danger trees and limbs (Enhanced Integrated Vegetation Management)
Feeder Improvement	Focusing on improving the distribution assets that are least performing to drastically reduce outage events
Distribution Automation	Using innovative and proven technologies such as switches for automatic fault isolation and restoration in concert with AMI to monitor and optimize the performance of the distribution system and monitor customers quality of service
Load Growth	Meeting the need for load growth and system enhancement to maintain the required reliability and ability to move load under contingency conditions (DA and Emergency Conditions)
Cable Replacement and Enhancement	Treating and/or replacing cable and related joints/elbows/splices that are reaching “end of life” before failure at an accelerated pace
Selective Undergrounding	Undergrounding selected areas of the mainlines as a pilot to improve reliability and reduce customer impact in areas where reliability cannot be enhanced with other appropriate measures

Five Year District of Columbia Distribution Budget – 2012-2016

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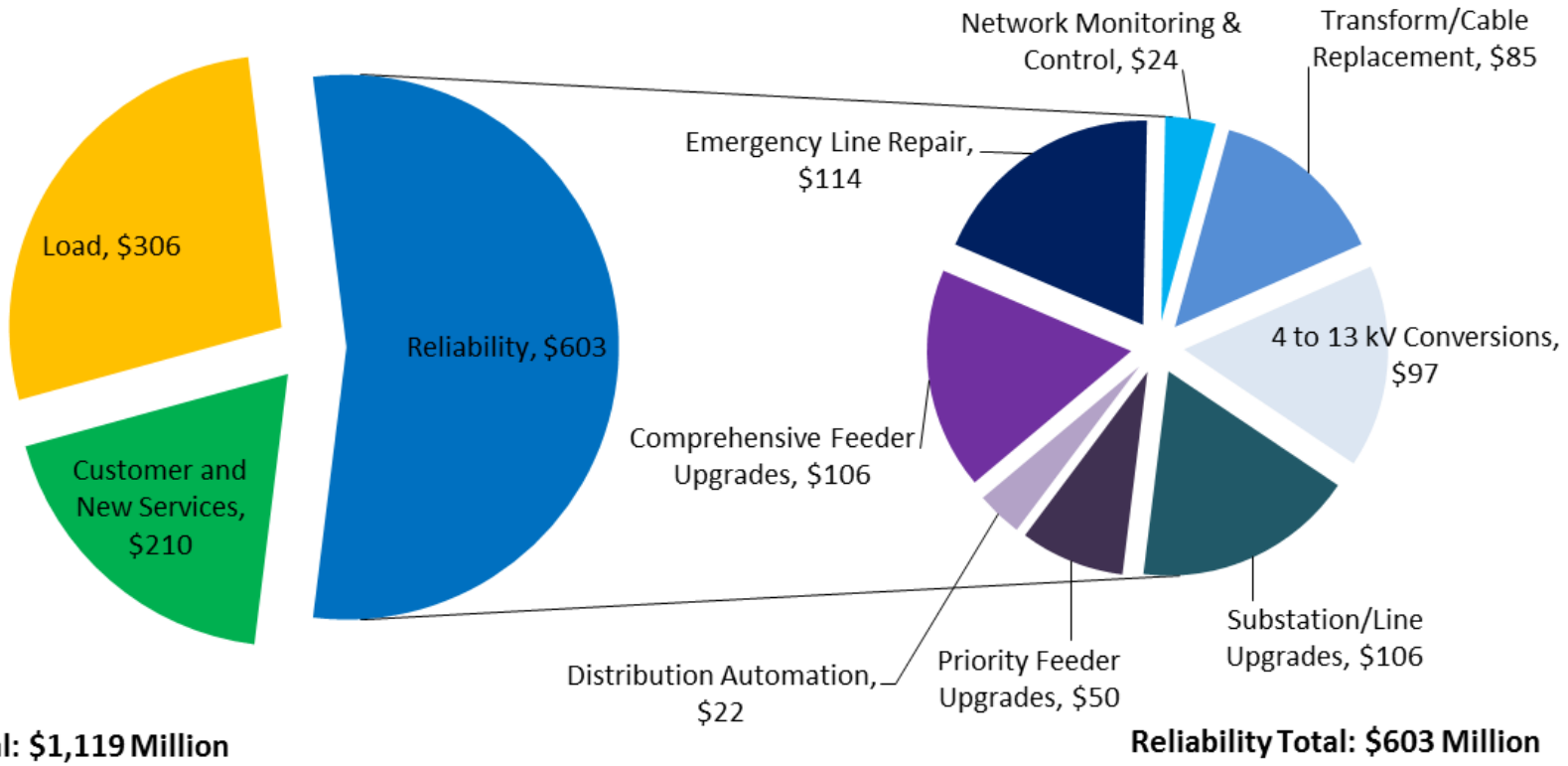
DC Total Budget and Reliability Breakdown ($Millions)



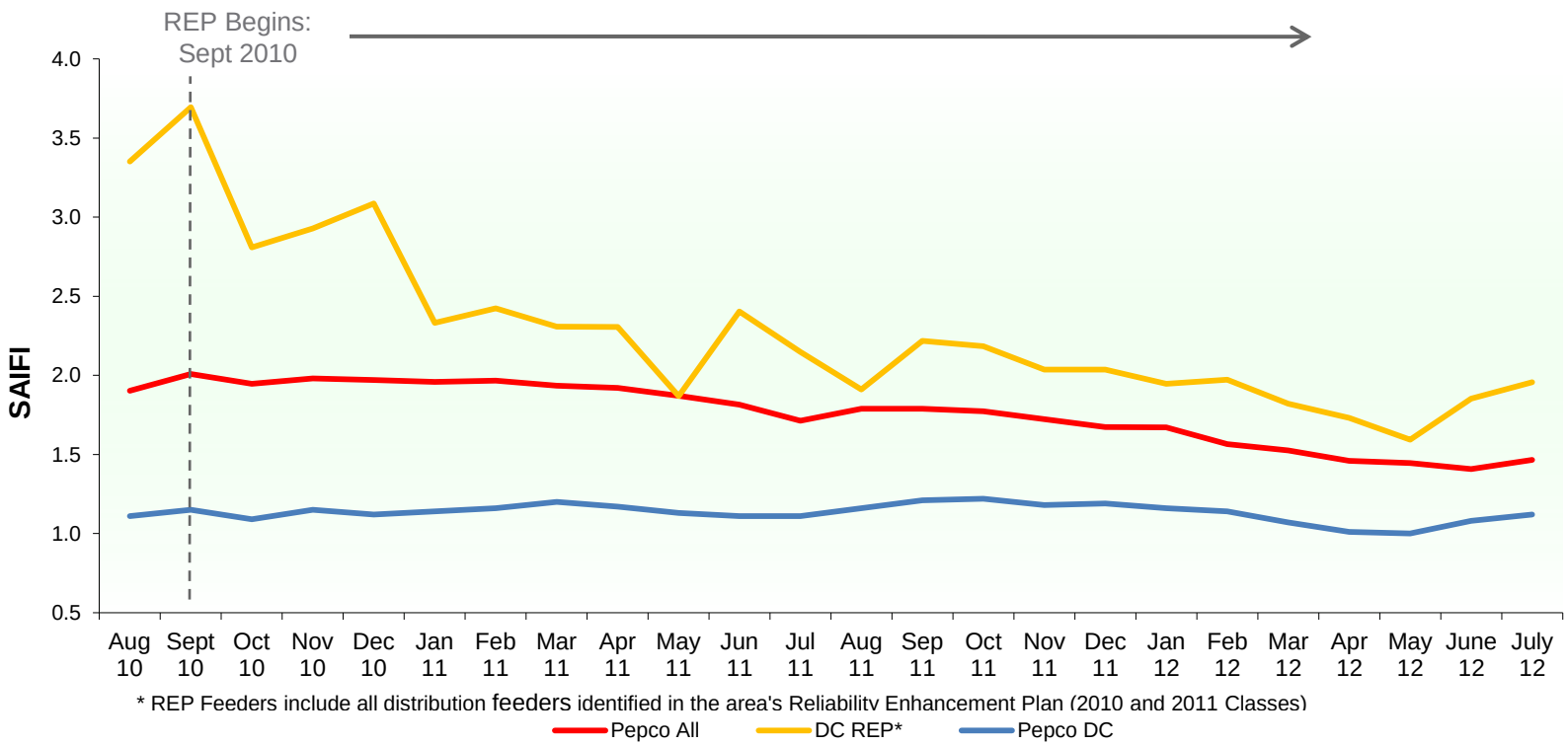
Total: $1,119 Million

Reliability Total: $603 Million

- Total rate base for the District of Columbia $1.16 Billion
- Reliability expenditures were $238 million over the past five years and will increase to $603M in the next five years
- Load expenditures were $140 million over the past five years and will increase to $306M in the next five years

Pepco System, DC and REP Feeders Performance – Average Number of Interruptions

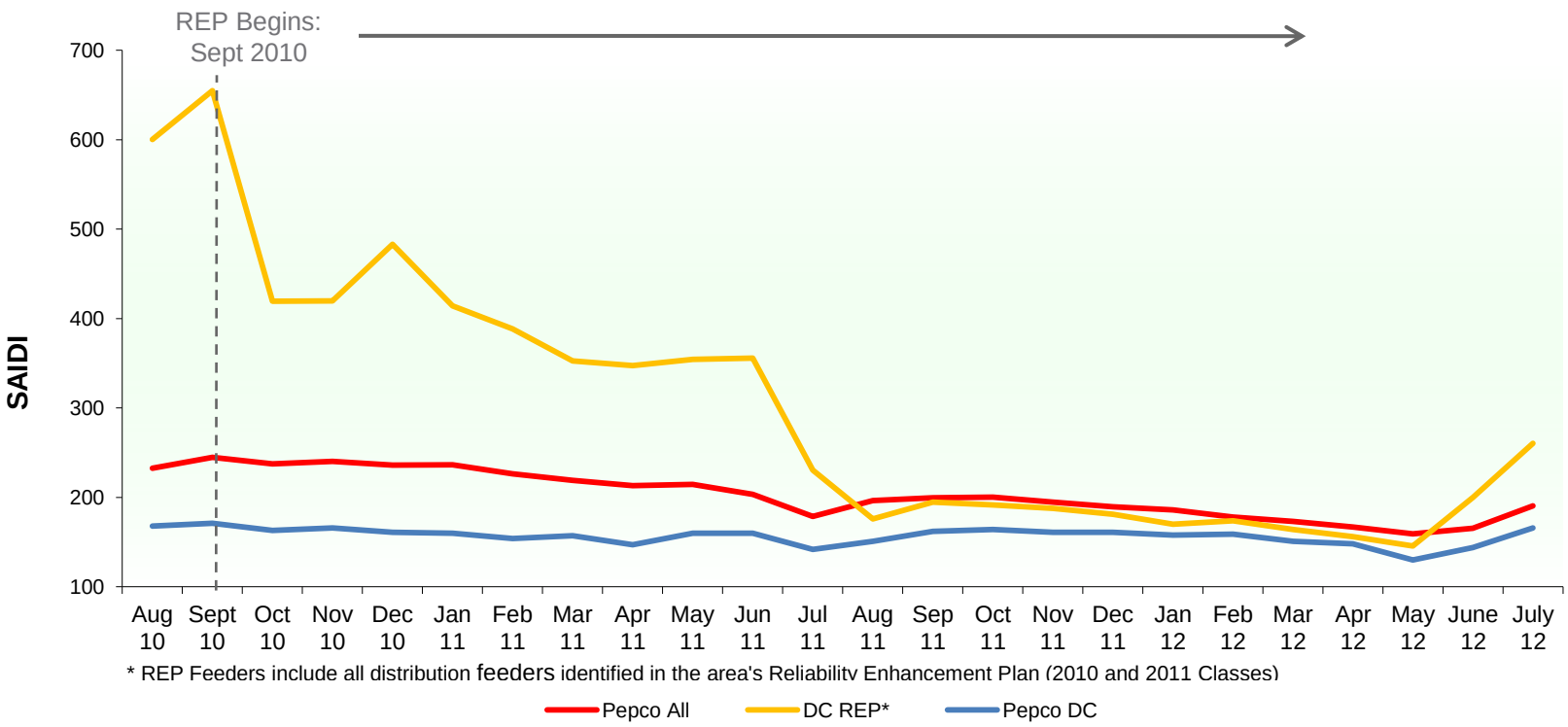
Pepco REP Feeders – SAIFI (MED Exclusive)



SAIFI – System Average Interruption Frequency Index;
MED Exclusive – Excludes Major Event Days

Pepco System, DC and REP Feeders Performance – Average Duration of Interruptions

Pepco REP Feeders – SAIDI (MED Exclusive)



SAIDI – System Average Interruption Duration Index;
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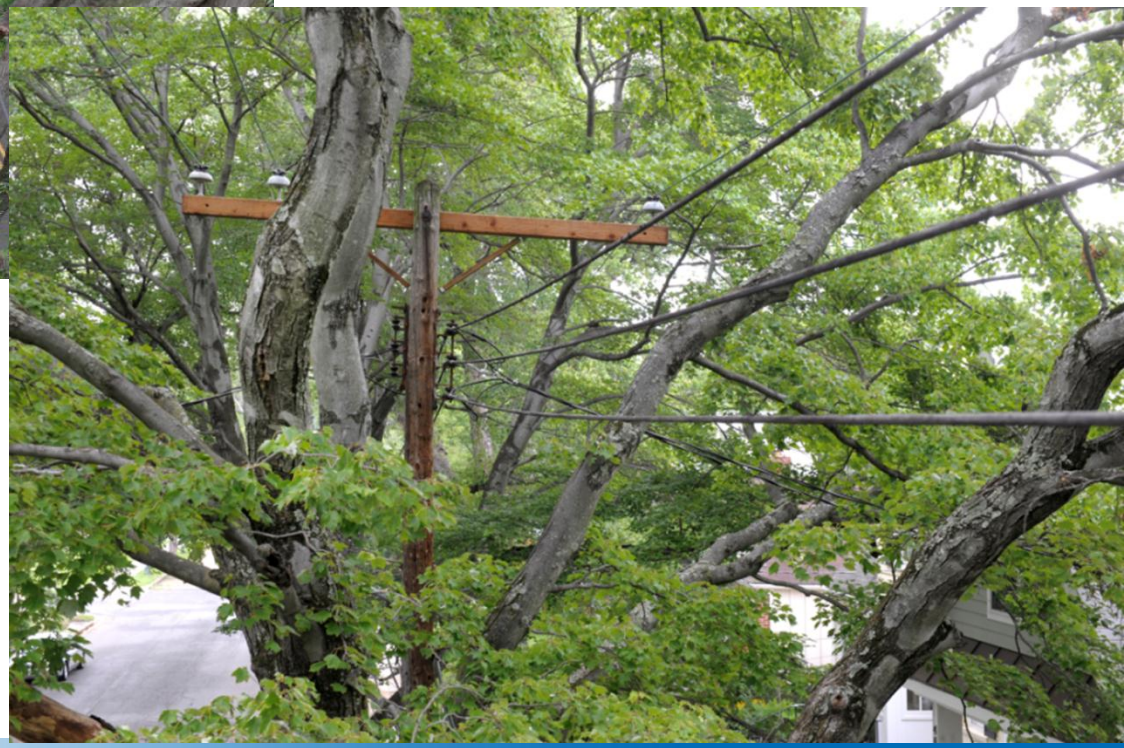
Historical Tree Preservation Regulations

- Precedents set through a number of regulations, historical statutes and policies have resulted in the city's current tree canopy, resulting in the existing tree-to-wire conflicts
- Best practices, ANSI and other standards emphasize the prevention of tree to wire contact
- Key historical items include:
- **1892** – *Act for the Preservation of the Public Peace and the Protection of Property within the District of Columbia*
  - "…unlawful for any person willfully to top, cut down, remove, girdle, break, wound, destroy, or in any manner injure…any tree not owned by that person
- **1960** – *Trees in Public Space Washington, DC Manual*
  - "Utility lines must be cleared by the use of directional clearance methods only – topping and drop crotching are prohibited…" (note: this goes against today's vegetation management best practices which recommend "topping" or "dropping" of leads in order to directionally prune growth away from power lines)
  - Compliance with this requirement requires relocating the wires as opposed to directional clearance meaning the removal of conflict portions of the tree so that the future growth is directionally away from the wires
- **2002** – *Urban Forest Preservation Act of 2002*
  - Spelled out punishments (monetary penalties and possible imprisonment) for violation of 1892 Act, also required 20 days written notice prior to performing any vegetation management work
- **2004** – Removal and Pruning Policy Directive
  - Prevents Pepco from shifting from a 2-year to a 4-year growth pruning cycle

Tree Conflict and Overhead Lines

4300 Block of 46th Street, NW – Feeders 14766 (Top) and 15945 (Bottom)
Details: Large oak trees growing through the feeders; tree wire installed and spacing between wires adjusted to line up with opening in tree; reduced spacing



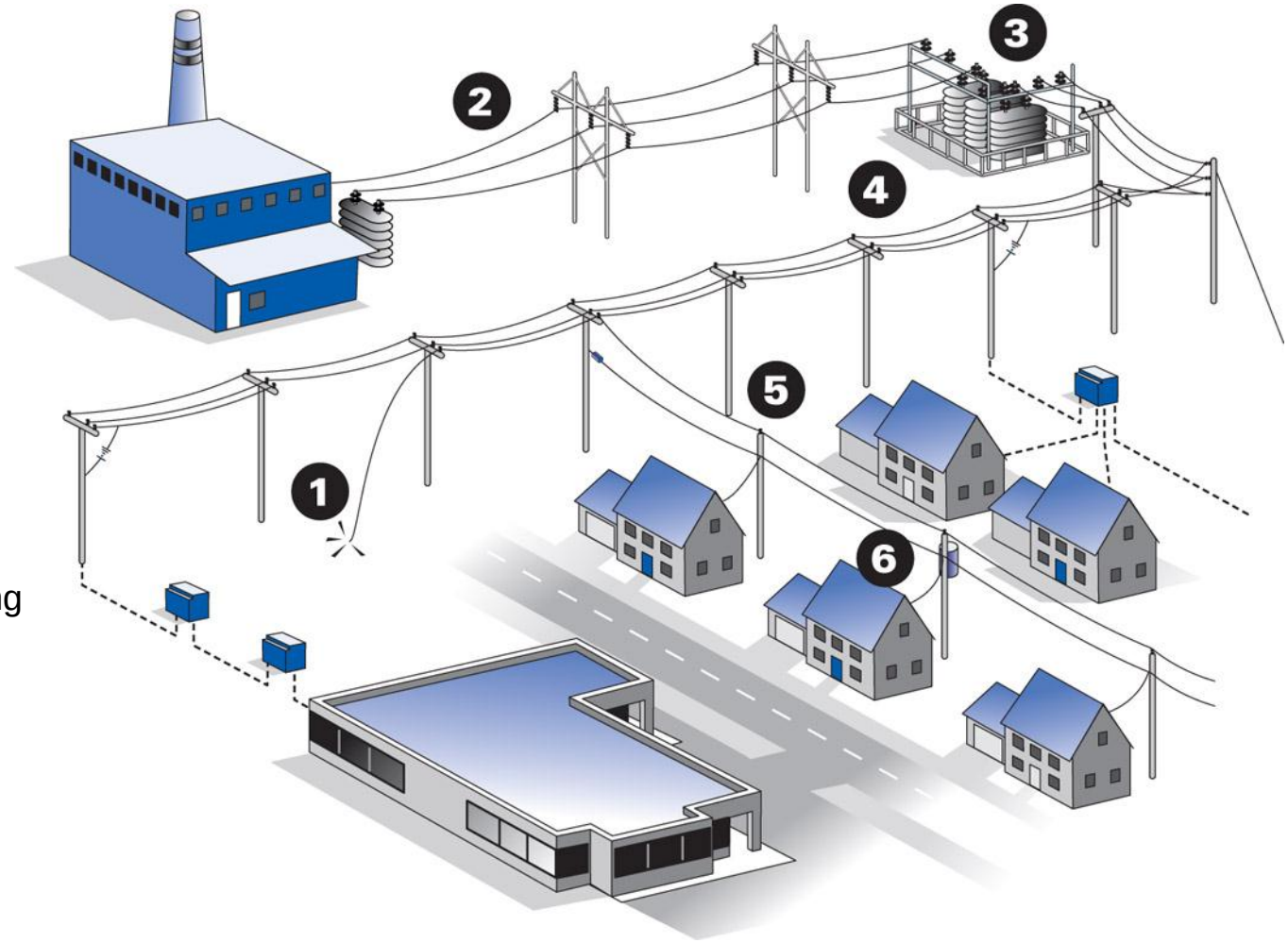
4800 Block of 48th Street, NW – Feeder 310 Details: Half dozen conflict maple trees in one street; secondary wires raised close to primary to clear branches; primary wires spacing adjusted to allow tree to grow between wires

Power Restoration

In the event of severe weather which knocks down trees, that damage the electric system, Pepco repairs the equipment which will restore the largest numbers of customers first.

Generally, the sequence is as follows:

1. Downed live wires or potentially life-threatening situations and public health and safety facilities without power
2. Transmission lines serving thousands of customers
3. Substation equipment
4. Main distribution lines serving large numbers of customers
5. Secondary lines serving neighborhoods
6. Service lines to individual homes and businesses



Regional Mutual Assistance Groups
Who are they?

- Over the past 70 years electric utilities have formed various Regional Mutual Assistance Groups (RMAGs). These groups have provided a cooperative, regional approach to identify and mobilize resources in an entire geographical region allowing for the safe and efficient release of resources in a timely manner

- These mutual assistance crews are trained linemen skilled in the techniques to restore electric service after major system damage occurs. In order to perform their work they travel from other states and bring with them the trucks and specialized equipment needed to perform their work. This can require anywhere from a few hours to several days of travel time

- These groups are modeled after various emergency management organizations such as the fire fighting groups that respond to wild fires out west

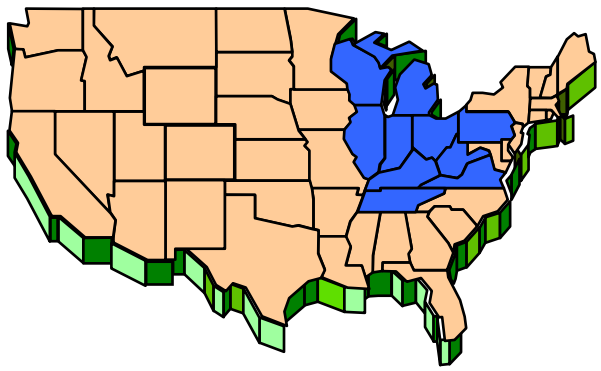
Mutual Assistance Program

- Mutual assistance organizations provide:
  - Qualified Distribution and Transmission line personnel
  - Tree Trimming/Vegetation Management personnel
  - Subject matter expertise to help direct the crews in restoration activities
  - Trucks, tools and specialized equipment for restoration crews
  - Damage Assessment resources
  - Safety and vehicle maintenance personnel

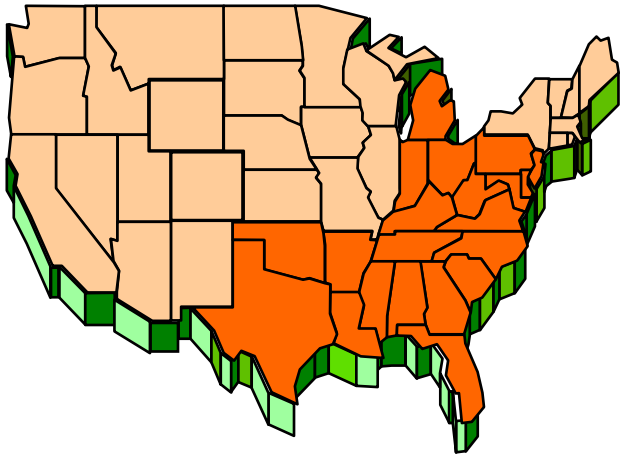
- PHI provides:
  - Logistics (food, housing, fuel, staging sites, etc.)
  - Material and equipment for restoration activities
  - Crew guides
  - Coordination, scheduling and assignment of work locations

- Benefits of mutual assistance program:
  - Immediate access to large number of resources and coordinated response
  - Scalable response depending on need and extent of damage

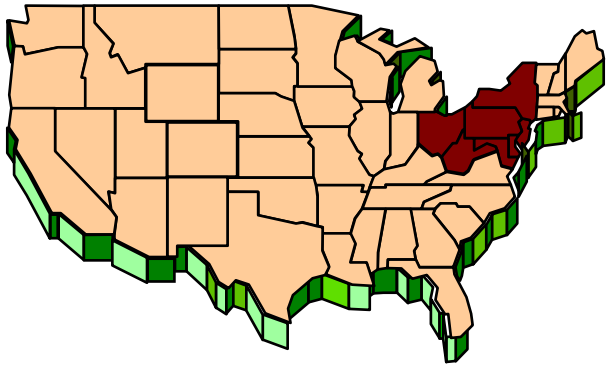
Regional Mutual Assistance Groups



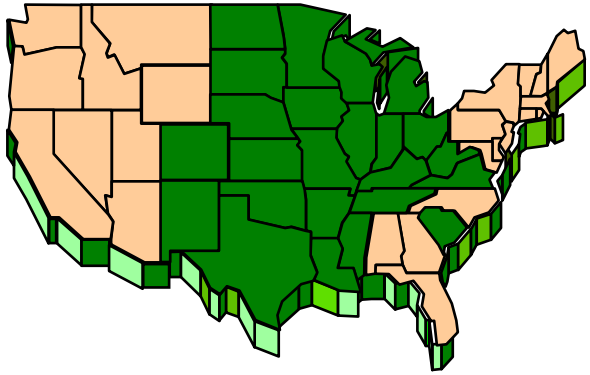
Great Lakes Mutual Assistance



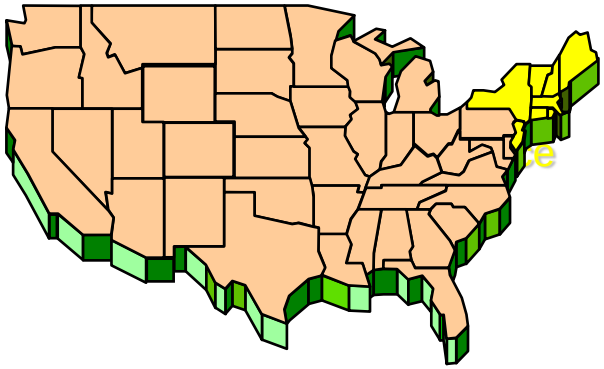
Southeastern Electric Exchange



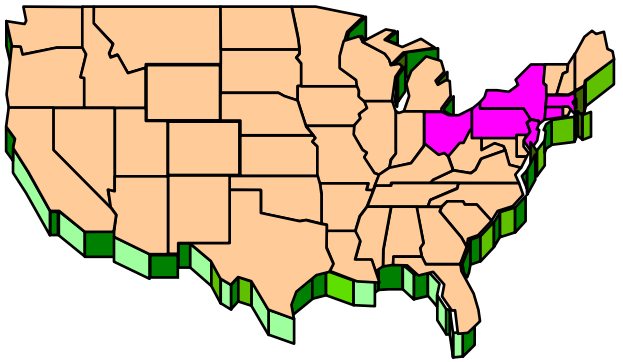
Mid-Atlantic Mutual Assistance



Midwest Mutual Assistance



Northeast Mutual Assistance



New York Mutual Assistance Group